

MURPHY (J.B.)

COMPLIMENTS OF THE AUTHOR.

# Traumatisms of the Urinary Tract.

BY

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Physicians and Surgeons, Chicago; Professor of  
Surgery, Post-graduate Medical School and  
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## TRAUMATISMS OF THE URINARY TRACT.

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BY JOHN B. MURPHY, A. M., M. D., OF CHICAGO.

Professor of Surgery and Clinical Surgery, College of Physicians and Surgeons, Chicago; Professor of Surgery, Post-graduate Medical School and Hospital; Attending Surgeon to Cook County Hospital; Attending Surgeon to Alexian Brothers' Hospital; President National Association Railway Surgeons, etc.

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The first systematic treatment of traumas of the kidney was given by Rayer in 1840. The subject was not advanced by the writers of the next thirty years. The great Simon took it up in 1876 and advanced it to a higher stage than that of a collateral subject. He was followed by Maas in 1878. From the time of the writings of the last two authors the subject has received careful consideration at the hands of many writers. Experiments and close clinical observations have given results upon which scientific treatment may be based. The most striking work that has appeared in this period is that of Edler, (*Traumatische Verletzungen der Parenchymatoesen-Unterleibs Organe: Archiv für Klin. Chirurgie, B. 34, 1882*). This work contains a large number of valuable statistics, although there is little advancement made in

the symtomatology and pathology of the authors first mentioned. Other able works are those of Grawitz and Schlange.

Injuries of the kidneys may be classified as: First, contusions, those without laceration of the external tissues. Second, penetrating wounds, involving laceration of the tissues as well as of the kidney. Third, ruptures into the peritoneal cavity, whether from penetrating wounds or contusions.

#### CONTUSIONS OF THE KIDNEY, WITHOUT EXTERNAL WOUNDS.

In considering this group we must be mindful of the fact that these injuries vary greatly in degree. The simple contusions, in which there is a slight hematuria, without tumefaction or phlegmon in the region of the kidney are of common occurrence, and require but little immediate attention from the surgeon. Rest in bed for three or four days, abstention from work or violent exercise for ten or twelve days longer is all that is necessary in the treatment of such cases; though they should be carefully watched for secondary lesion.

The more serious cases of contusions (that is, contusions accompanied by severe hemorrhage, both within and around the kidney, with tumerfaction and phlegmon) are not of rare occurrence, and tax the surgeon's



judgment and skill to conduct them to a successful termination. Of this class Edler collected ninety cases, to which Grawitz added eighteen, making a total of 108 cases collected up to January, 1889. Since that time I find in the literature a rapidly increasing number of cases.

Examples of this class of cases are the following:

Case I. R. D., aged 11 years, came under my observation the 10th of May, 1885. He was returning from school and was run over by a horse car, one wheel passing directly over his abdomen. Patient was taken home in a collapsed condition and remained so for several hours; he was paralyzed in the right lower extremity, and was unable to urinate. An examination was made and it was found that he was very tender in the area over the left kidney, and that the spinous process of the first lumbar vertebra was fractured; also the 11th and 12th ribs on the left side. There was very slight external evidence of an injury to the abdomen.

Restoratives were administered, and eight hours after the injury the patient micturated, the urine containing a large quantity of blood. The following day the tenderness in the region of the left kidney increased. There was a sense of fullness and pressure there, as expressed by the patient. The blood continued

in large proportions in the urine. This condition remained unchanged until the fifth day, when the tumor became quite marked, and the patient developed a temperature of 101 (probably the absorption fever of Bergmann and Angerer). The fever continued to increase, until at the end of three weeks it had reached 102½ in the evening. The patient was emaciating rapidly. The tumor now filled up a greater portion of the left side and extended as far as the umbilicus. The blood had disappeared from the urine. It still contained some albumen and debris. A Lumbar incision was made, and about a quart of bloody pus and urine evacuated. An opening about an inch long was found extending from the pelvis of the kidney upward and outward. Urine flowed from the fistula for seven months. The paralysis of the limb (produced, undoubtedly, by the fractured spinous process) entirely disappeared, and the patient made an excellent recovery, having no evil effects from the injury.

Cases II and III occurred in the practice of my colleague, Dr. E. W. Lee.

Case II. C. J., aged 10 years, run over by a street car. He was caught under the car in such a manner as to "double him up." Dr. Lee found him in a condition of extreme collapse and reaction was not fully established for nearly 36 hours. The urine was bloody.



An area of dullness could be outlined on the fourth or fifth day on the right side over the kidney; it was quite extensive. There was general abdominal tenderness. The case progressed without any marked symptoms for about three weeks, when a well-defined tumor could be outlined. A temperature developed, showing absorption. A lumbar incision was made, evacuating a quantity of pus and urine. It took about four months for the fistula to close.

Case III. Wm. L., aged 24 years, while crossing a railroad track October 28, 1882, fell forward, the right hypochondrium coming in contact with the rail. He felt faint and sick immediately, and was removed to his home. Dr. Lee found him somewhat collapsed, pulse rapid and weak, and the urine bloody. Next morning a distinct area of dullness could be outlined over the right kidney in front; temperature normal; pulse slower, and fuller. The urine was occasionally bloody for the next week. He developed an evening temperature of 102 degrees, and November 13 had a chill, followed by a temperature of 103 degrees. November 14 a lumbar incision was made; evacuated about a pint of pus and bloody debris. Urine drained through the opening, which closed on December 17.

Case IV occurred in my service at the

Alexian Brothers' Hospital, in July, 1892. Frank F—, aged 22 years. He was thrown against the edge of a coal bin in a railroad accident. Immediately following the injury he was severely shocked, although he did not lose consciousness. When brought to the hospital he was suffering from severe pain in the abdomen; tenderness of the right kidney; no laceration of the external parts; urine contained a considerable quantity of blood. On the third day a distinct tumor could be felt at the position of the right kidney. There was no infiltration of the tissue, and no phlegmon. The patient's temperature did not exceed  $99\frac{1}{2}$ . These symptoms continued for about ten days, and then began to subside; the tumor diminished in size; the blood gradually disappeared from the urine; and at the end of five weeks the patient left the hospital with a slight enlargement of the right kidney; urine normal. These suffice as examples of injuries of this class. We will now take up their cause, and the method of their production.

The most frequent causes of injuries to the kidneys are blows or kicks (particularly from horses), and falls in which the region of the kidney is brought in contact with a sharp point or edge. The kidney suffers more frequently when the force comes from the front or side, not so often when it comes from behind, except as in railroad injuries, where the entire

body is thrown with great force upon a flat surface; here the kidneys may be considerably lacerated.

Indirectly, the kidney may be lacerated by suddenly doubling the body together, as illustrated in one of Dr. Lee's cases. All of these injuries have but slight manifestations upon the surface of the body of their severity, because at this point the surface of the body is yielding and readily gives under force. Not infrequently the ribs, or the spinous processes of the vertebræ are fractured, which shows the severity of the force. The anatomical condition following injuries of this class is as follows: Where the force is from in front we have the kidney protected by the intestine and the soft wall of the abdomen anteriorly; but posteriorly we have the hard resistance of the rib, and to the inner side the spinal column. When the rib is fractured in conjunction with an injury to the kidney we may have the latter punctured, as in the case of injuries of the pleura or lung, or we may have it lacerated in the line of the rib from pressure. The kidney is found torn in a more or less transverse or radiating direction from the hilus to the periphery, frequently dividing the kidney through and through, into an upper and lower portion; one of these may be entirely separated from its connection with the remaining portion of the kidney or pelvis. The following



explanation has been given as to the cause governing the direction of the laceration:

The kidney is known to be made up in fetal life of from twelve to fifteen small bodies, the so-called "renculi," which, in the first years of life, adhere and unite, leaving greater or lesser depressions at the line of union; and in many cases a deep fissure continues through life. There is also a depression in the capsule at the position of union of these bodies, and the blood vessels and connective tissue loop and separate to a considerable extent along these lines; that is, their communication and interlacing is less at this point than any other portion of the parenchyma. This creates a congenital locus minoris resistentiæ, and accounts for the direction of the line of laceration. The tendency to lacerations in this direction Gravitz could not establish by experimental contusions in the dead subject. Still, he believed this was due to the absence of turgor in the cadaver. Aside from the lacerations we frequently have contusions of the parenchyma, accompanied by bloody and urinary infiltration of the tissue. Extensive parenchymatous hemorrhages accompany almost every contusion of the kidney. Severe hemorrhages do not take place except where the larger branches at the pelvis are punctured. The injuries to the cortex rarely bleed severely, but transverse lacerations of the hilus close to the

attachment of the ureter, not infrequently rupture large blood vessels that run parallel to the long axis of the kidney, from which extensive hemorrhage takes place. It is not uncommon to have a vessel of one-eighth of an inch in diameter running parallel to the longer axis of the kidney. This I have frequently observed on the injected cadaver and in my experiments on dogs, and the surgeon should always be guarded against incisions in this position. Another condition that favors severe hemorrhage from laceration of the kidney is the large renal artery, and the high pressure that must exist in its branches.

In order to have a urinary infiltration of the parenchyma of the kidney, it is necessary that the pelvis be lacerated. When the pelvis and capsule are not lacerated a large blood accumulation may form in the parenchyma of the kidney, and but little appear in the urine, and none escape into the surrounding cellular tissue. But when the capsule is lacerated the blood will pour into the retro-peritoneal cellular tissue, and form a large tumor that may extend from the diaphragm to the pelvis. It is not uncommon to have both the capsule and pelvis lacerated. In these cases the blood finds a natural outlet through the ureter, and though a considerable tumor may form shortly after the injury, with a free communication with the cel-

lular tissue, it is not uncommon to have this entirely disappear by drainage through the ureter. In rupture of the ureter in connection with laceration of the kidney no such drainage takes place, and the tumor remains and increases rapidly in size; finally a phlegmon is formed, involving a greater portion of the side.

The condition is entirely changed when the peritoneum is lacerated as well as the kidney. Here you have a most dangerous complication. This occurs most frequently in children, as the peritoneum is more friable and its tension is greater in early life.

#### SYMPTOMS.

The pronounced symptom immediately after injury is shock, and this shock has no specific characteristics to indicate a lesion of the kidney. It is the shock of severe abdominal injury, and would be present in impalement, contusion or laceration of any of the viscera of the abdominal cavity. It is not prolonged, however, beyond a few hours, except when accompanied by severe internal hemorrhage. Almost immediately after the injury, and before the symptoms of shock have subsided, the patient complains of severe pain in the neighborhood of the injured kidney. This pain is increased very much on pressure or manipulation. The physical signs produced by the hemorrhage will depend: first, on the quantity;



and second, whether it is retained in the cellular tissue or admitted into the peritoneal cavity. If it be retained in the capsule or cellu-

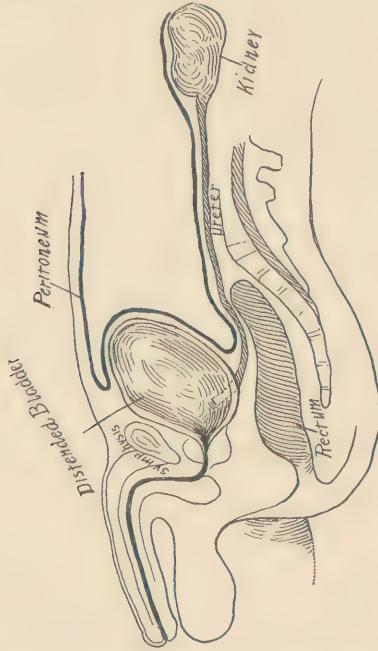


FIG. 1. DIAGRAMMATIC SKETCH SHOWING RELATION OF PERITONEUM TO KIDNEY, URETER AND BLADDER, AND DISTANCE BETWEEN PERITONEAL CAVITY, AND SYMPHYSIS PUBIS WITH BLADDER DISTENDED.

tent depending upon the quantity of blood. When the peritoneum is lacerated the blood lar tissue, palpation and percussion will elicit the signs of tumor around the kidney, the ex-

escapes into the peritoneal cavity, and the evidences of tumor are absent both in the neighborhood of the kidney, and in the great majority of cases in the peritoneum, unless the quantity of blood is very large, in the latter case you will have the symptoms of acute anemia. When the peritoneum is ruptured the manifestations of collapse are also more profound and of longer duration. (See Fig. I).

An almost invariable symptom, and one of great importance, is that of hematuria. It is often excessive, but in rare cases it is entirely absent. The quantity of blood in the urine bears some relation to the extent and position of the laceration; and when it is great the probability is that one of the large vessels of the pelvis is involved.

Hematuria without tumefaction indicates that the capsule is not lacerated. The urine may be simply colored with blood, or it may be almost pure blood and coagulate when voided. Intermittent hematuria after a laceration of the kidney is not uncommon. The intermission is produced usually by a coagulum forming in the ureter. During the intermission there is severe pain in the renal plexus, which may extend down into the testicle, as in renal colic of calculus. Three or four days after the laceration the tissues at the side commence to show urinary infiltration. If the urine be aseptic it does not produce sup-

puration, but an infiltration of the tissues, accompanied by excessive exudation in the cellular tissue, muscles and lymph spaces. This infiltration increases the density of the tissue, so that it often has a ligneous feeling, which prevents the detection of fluids by fluctuation, notwithstanding there may be a large quantity present. Percussion enables us to determine the outline and extent of the infiltration and accumulation. Gradually the tumor increases in size; its outlines become more marked, and after a week or ten days, or possibly two weeks, the patient commences to have a temperature that exceeds 100, fibrin intoxication or resorption fever.

From the quantity and character of the blood, except where it is very minute, it is impossible to say whether it comes from the kidney or bladder. Occasionally we have an angle-worm clot, or a bloody cast of the ureter. When present it is pathognomonic of renal hemorrhage. We have besides these symptoms, those of vesical tenesmus or bladder colic. This was noticed most frequently by Simon, and is due to a coagulum forming in the neck of the bladder, preventing the escape of urine. The renal and bladder colics both subside as soon as the clots break down and the free passage is re-established. The hematuria lasts from one week to three; rarely longer.

The above is the train of symptoms commonly



present, except in the complicated cases; that is, where you have along with the laceration of the kidney a rupture of the intestines, stomach, gall-tracts, etc. The symptoms will vary in accordance with the particular organ injured, and would have in addition symptoms peculiar to that organ. One of the most difficult complications, and indeed, one in which it is impossible to make a diagnosis without exploratory incision, is the laceration of the spleen, as is shown in the following case.

J. P—, admitted to Cook County Hospital in May, 1879. Patient was in a buggy attached to a run-away horse, and was thrown from the vehicle and doubled up around a lamp-post, the force being centered below the margin of the ribs, and a little to the right side. When admitted to the hospital two hours later he was very much collapsed; in a cold, clammy perspiration, and complained of great pain in the abdomen; pulse feeble and frequent; lips pale and exsanguinated. The urine contained a large quantity of blood. Percussion showed dullness on the right side, and there was a fracture of the eleventh and twelfth ribs. The patient continued to fail, and died four hours after admission.

Post-mortem: Peritoneal cavity full of blood. The spleen was macerated to a pulp. The left kidney was torn transversely in many places, and hung by shreds to the pelvis. The peri-

toneum over the kidney was also torn. The ribs did not penetrate the kidney. There was no injury to the intestines nor other internal organs. Cause of death, hemorrhage and shock.

Fractures of the spine, rupture of the diaphragm, and rupture of the bladder occasionally accompany lacerations of the kidney.

Prognosis: Of the 108 cases reported by Edler, 58 terminated in recovery.

#### PATHOLOGY.

We have in the nephritis traumatica primary healing and secondary healing. Primary healing takes place in the greater percentage of the cases; that is, the repair without a localized abscess or external opening. Of the 58 cases above reported as recoveries, 46 were of this class, and the average time was about three weeks. With secondary infection we have suppuration and a large abscess; or a large accumulation of blood, which requires considerable time for absorption and cicatrization. In these cases it is not exceptional to have bloody urine for weeks during the process of repair. Cicatrization takes place first outside of the kidney, and gradually approximates the kidney substances itself. A loose connective tissue is developed at the point of laceration. Tuffier and Paoli believed that they observed in their experiments the repro-

duction of glomeruli in the cicatricial mass; but Barth in his more elaborate and extensive experiments and observations has come to the conclusion that the glomeruli are not reproduced. Maas is of the same opinion, and has found that after primary healing the scar continues to contract until a deep fissure is produced at the position of the wound. If the lacerations have been extensive, when the process of repair is complete and the contraction has taken place, a great portion of the secreting surface may be destroyed; but this is rapidly compensated for by the hypertrophy in the healthy tissue. In the complicated cases of rupture of the kidney, or the cases of secondary union with suppuration, the mortality is greater. Grawitz found in 17 cases of secondary union 10 recoveries.

The cause of the suppuration has not been satisfactorily explained. Healthy urine does not produce suppuration, as has been shown many times by experiments, and as I have also demonstrated experimentally; but it does prepare the tissues for suppuration, necrosis and gangrene, that is, tissues infiltrated with urine if they become infected, rapidly break down and slough. This should be kept in view in treating all traumatisms involving the urinary tract. We have before the injury presumably a healthy condition of the bladder and kidneys. We should be careful to perform no operation



nor procedure that would be liable to infect the tissues; for if infected the suppuration would be great. It was for a time believed that alkaline urine would produce suppuration; but that is not true, unless the alkalinity is produced by decomposition. Urine will produce an inflammation, or an excessive regenerative reaction, or cell proliferation; but without the admission of microphytes from without there will be no suppuration. Experiments have shown that lacerations and incisions of the kidney, where there is no loss in substance, repair themselves in from ten to twelve days. Where infection takes place the healing is very much retarded, and if the circulation is defective in portions, it is likely to become necrotic, as in the case recently reported in the New York Medical Record. The modus operandi of infection of the kidney is first and most frequently along the urinary tract, and second through the blood; third through the intestinal canal.

First Source.—The most frequent source of infection is through the urinary tract from below, as from gonorrhea, cystitis, or more frequently in connection with injuries to the kidney, faulty catheterization. The latter procedure is so frequently performed in a careless; indeed, I might say, dirty manner, that many of the cases receive their infection from this source.

Second Source.—The kidney is recognized as an eliminator of many kinds of bacteria; it is also recognized as the position in which emboli in pyemia, erysipelas, pneumonia, scarlet fever and diphtheria are most frequently arrested, and produce suppurating foci; and as in injuries of the kidney, we have a *locus minoris resistentiæ* it would therefore be expected that the microphytes would here be arrested, and that they would find a favorable nutrient material for their development. The experiments of Rinne on the lower animals, however, do not justify this theory.

Third Source.—The third channel for infection is through the injury of a portion of the intestinal tract in close proximity to the lacerated kidney. It is not necessary that there should be a perforation of the bowel, but a traumatic ulcer of the bowel may infect the lymphatics, and by its contiguity to the injured kidney produce a suppuration of the latter.

#### CAUSES OF DEATH.

Of the 108 cases quoted above 50 terminated fatally—46.3 per cent. Of the 50, 18 were complicated, giving us a mortality in 90 uncomplicated cases of 35.5 per cent. It is my belief that this mortality is too high, as many of the milder cases were not reported. The causes of death may be divided into: First, shock; or better, shock accompanied by hem-

orrhage. Fourteen of the 108 cases died from this cause on an average of from fifteen to twenty hours after the injury. The quantity of blood found in the abdomen was very much less than would have been necessary to produce death from injuries to the extremities or blood vessels without the element of shock. We know that death from hemorrhage is due not alone to the quantity of blood lost, but that the rapidity with which the blood pressure is lowered is an important cause of sudden death from hemorrhage. When the peritoneum is opened the shock is greater. Notwithstanding that the urine does not produce suppuration, it does produce peripheral nerve irritation, and in that way adds greatly to the element of shock. Second, continuous hemorrhage for a long time produced death in eight cases. Third, suppuration of the kidney or peri-renal tissue, produced death in seven cases. Fourth, from uremia three deaths.

#### TREATMENT.

The treatment of injuries of the kidneys should be such as would overcome the causes of death in such accident. We find in the analysis of the causes of death primary hemorrhage and shock in 15.5 per cent of the cases. The first indication, therefore, to be met is the hamastasis; can we, by external pressure, by position, by manipulation, in any way lessen

the hemorrhage? No. Where we have the symptoms of exsanguination following traumatism, with bloody urine and local tenderness, there is but one means of suppressing that hemorrhage, and that is by operation, effecting compression or ligation of the renal vessels, or extirpation of the kidney.

Is such an operation justifiable?

In cases of laceration of the kidney with severe symptoms it certainly is. Not only can we extend some hope to the 15 per cent who die from primary hemorrhage and shock, but we can also lessen the danger from the 9 per cent that die from secondary hemorrhage, making a total of 24 per cent of the cases whose chances would be increased by an immediate operation. In addition to this we can certainly lessen the mortality of the 16 per cent that die from complications, such as rupture of the gall-bladder, intestines, stomach, etc., by immediate action. The indication, therefore, in lacerations of the kidney with severe symptoms is immediate exposure of the kidney: (a) by laparotomy; (b) by lumbar incision; the former is always to be given the preference.

In modern surgery is there any other field where hemorrhage (primary and secondary), or lacerations of the viscera are allowed to continue with a mortality of 24 per cent without the surgeon making an effort to reduce it? It is my firm conviction that we are swerv-



ing in our obligations to our patient when we stand idly by and allow a condition that necessitates a mortality of 46.40 per cent to continue without making an effort to save the life of the patient.

The indication in the milder cases is the opposite. We should wait. If a suppuration or a large accumulation forms, it can readily be drained; this should always be done by the lumbar incision; and indeed, a portion of (or even the entire) kidney may be removed, two, three or more weeks after the injury, if it be indicated. The septic symptoms are usually very mild, showing but a low degree of intoxication, making but slight inroads upon the strength of the patient, and allowing the surgeon ample time to consider all the bearings of the case before he is compelled to operate. When drainage is established the opening should be large and kept patulous. It is preferable in these cases not to operate until the third or fourth week, as the injured tissues have by this time regenerated, and are in better condition to withstand the secondary infection, which frequently takes place after the operation, than they would be at an earlier time. Where the ureter is permeable the fistula will finally close, though it may continue to discharge for months.

The cases of traumatic nephritis in which the symptoms of uremia occur must be treated

from a medical standpoint, with water, diuretics and proper diet.

Penetrating wounds are rare accidents in railway surgery, and for that reason will not be considered in extenso here. I would merely say that the symptoms and indications are practically the same as for those of the sub-cutaneous variety, the greatest precaution being taken to keep the wound aseptic, and if the peritoneum be invaded as a complication, suture it immediately and shut it off from the renal lesion and drain in front.

#### TRAUMATIC RUPTURES OF THE BLADDER.

Injuries of this class are produced more frequently by railroad accidents than any other form of traumatism of the urinary tract. We will divide them into three classes. First, ruptures into the peritoneal cavity. Second, sub-peritoneal ruptures. Third, ruptures of the neck into the pelvic cellular tissue above the triangular ligament.

All of these may, or may not, be accompanied by external openings. More frequently they are not. Ruptures of the bladder have been recognized, treated and feared for centuries. Heinrich von Ruhnheisen wrote the first classical description of this class of injuries in 1663.

The ruptures may be produced by severe blows in the pelvic region; by the body being

thrown with great force against solid objects; by crushing injuries, as between bumpers, by being run over with heavy weights or wagons; they are frequently accompanied by fractures of the pelvis, the fragments of bone producing the laceration.

Bartels, in 1878, found in 504 injuries to the bladder 169 ruptures. Rivington, in 1882, reports 322 cases of bladder rupture, of these 183 were intra-peritoneal, and 119 extra-peritoneal. Of the 183 intra-peritoneal only one recovered. Of the 119 extra-peritoneal twenty-six recovered. A successful case of intra-peritoneal rupture occurred in the practice of Dr. Walter of Pittsburg, where he performed an immediate laparotomy and suture of the bladder. To Walter, therefore, belongs the honor of being the first to outline a rational treatment for ruptures of the bladder. The procedure previous to that, (and indeed, by many since) has been the permanent catheter. From the time of Simon it has been established that healthy urine in the peritoneal cavity does not produce septic peritonitis.

Why, then, should the mortality be so great?

While urine in the peritoneum does not produce suppuration, it does produce an abrasion, that is, an exfoliation on the endothelium of the peritoneum, and thus prepares the surface for infection and rapid absorption. Schlange,

in 1892, collected 33 cases operated; 22 for intra-peritoneal rupture, with 10 recoveries and 12 deaths; 10 for extra-peritoneal rupture, with seven recoveries and three deaths. At first sight this would seem to be a great advance; but I doubt if the statistic justify the conclusion that 40 per cent of these cases have been saved, as many unfavorable ones are not reported. Still, it does justify beyond question laparotomy for intra-peritoneal laceration. Let us take some examples.

In September, 1890, I saw with Dr. J. W. O'Connor, chief surgeon of the Denver & Rio Grande, a case at his Salida hospital. The patient had been injured in a wreck two days before. He was suffering from a fracture in the pelvis; had great pain in the abdomen; tender; tympanitic, and in no place could a distinct outline of dullness be determined. His pulse at the time we saw him was about 140; his temperature 101. Several hours after the injury he was catheterized and a small quantity of bloody urine obtained. A few hours later the catheter was again passed, and only a few drops of blood. The next morning catheterization was repeated, and by pushing the instrument in as far as possible, a large quantity of bloody urine (something like a quart) flowed out. Subsequently the catheter gave but a little clear urine. At the time we saw him his expression was bad; he was col-



lapsed, and his condition such that he would not tolerate any operative interference.

Diagnosis: Rupture of the bladder. Post-mortem the following day. The abdominal wall slightly infiltrated with serous exudate. Peritoneum excoriated, inflamed, and the pelvis contained a considerable quantity of sero-purulent urine and blood. Bladder contracted. There was an extensive laceration of the bladder on the posterior surface, extending through the peritoneum. A multiple fracture of the pelvis. Cause of death, peritonitis from rupture of the bladder. It is evident from the post-mortem that the small quantity of bloody urine, and the clear urine withdrawn with the catheter, were taken from the bladder. The large quantity withdrawn on the second morning was taken from the peritoneal cavity by the passage of the catheter through the opening in the bladder into the peritoneal cavity.

Dr. Fernand Henrotin kindly furnished me with the history of the following case: Male., aged 15 years. Admitted to the hospital April 6, 1895. A few hours before, while leaning over a banister, he lost his balance; fell three stories, landing on his hip and right side. Collapsed after the injury, but was not unconscious. No bones broken. Complained of very severe pain in the abdomen, the latter was tense and tympanitic. Inability to produce bowel movement. Fre-

quent vomiting and constant nausea. No urine was passed in the first twenty-four hours. A little blood was discharged after efforts at urination. No hemorrhage from the urethra. After catheterization a small quantity of clear urine was obtained. Laparotomy; large quantity of blood and urine in peritoneal cavity; laceration of bladder not found, as patient's condition was too extreme to permit prolonged search; abdominal drain; urine discharged through incision for three days and patient succumbed. Post-mortem not permitted.

#### DIAGNOSIS.

In arriving at a definite diagnosis in laceration of the bladder the history of the case must be taken into consideration, and a careful examination made of the boney framework of the pelvis. In the absence of fracture of the pelvis, with the remaining symptoms of rupture of the bladder, the chances are that the rupture is of intra-peritoneal variety, and not a rupture into the cellular tissue of the pelvis. On the other hand, when it is accompanied by a fracture of the pelvis, the bladder is very likely to be lacerated at the neck, and extra-peritoneally, careful palpation and percussion should be made of the abdomen and pelvis. The area of dullness may be found either located centrally or to one side. Palpation through the rectum and vagina may assist us

in outlining the tumor. If the resistance to the wall of the abdomen be too great, it will be necessary to place the patient under an anæsthetic, and to prepare for a laparotomy. The diagnosis must be made at the first examination; that is, we are not justified in allowing the patient to go for hours and hours with an indefinite idea of the condition.

It will be noted so far that I have refrained from mentioning the catheter. The catheter should not be used as an aid to diagnosis if the patient is able to urinate, but if he is not able to urinate it must be passed, and all the aseptic precautions taken in inserting the catheter that would be taken by a man with an aseptic conscience if he intended to insert that catheter into the peritoneal cavity; for if the patient has a rupture of the bladder it is possible that the catheter will be passed directly into the peritoneal cavity, and even though it be not passed through the peritoneum and the rupture exists the catheter will set up a decomposition of the urine and blood in the bladder, and this will rapidly spread through the opening into the peritoneal cavity. It is my belief (and it is based on the observations of a long hospital service), that there are more lives sacrificed and more subsequent trouble and pain produced by uncleanly catheterization than by any other operative procedure indulged in by physicians to-day. True,

the majority of physicians to-day do not spit on the catheter for the purpose of lubricating it; but many do slip their hands into their pockets, draw out the catheter, and insert it without disinfecting the catheter, their hands or the genitals. In this connection I do not allude to the permanent catheter. That will be considered under the subject of treatment.

The information that we can derive from catheterization, is the quantity and character of the contents of the bladder. If it be small and bloody and the patient has not urinated for a considerable time previous to the injury, it signifies rupture. We must be careful to note that the eye of the catheter is not closed with a blood clot, as a very distended bladder under such circumstances could not be evacuated. If no urine is withdrawn from the bladder it may be filled with a colored salt solution by means of a siphon attached to the catheter, the quantity being first measured exactly, using on the average a quart of water. This should then be made to siphon off and again measured. If there be a noticeable difference in the quantity, and the catheter is not closed by a blood clot, the chances are altogether in favor of a rupture of the bladder. The increase in the area of dullness in the abdomen should be noted before filling, while full and after emptying the bladder. When this procedure is undertaken every prepara-



tion must have been made to do an immediate laparotomy.

Now if the fluid does not return, and we are convinced that it is a rupture of the bladder, the question arises; is it intra-peritoneal, sub-peritoneal, or intercellular? If of the intra-peritoneal variety, the fluid passes in with less force, and the dullness will become more diffuse. In the sub-peritoneal variety, as shown by the following history, the tumor will be circumscribed, and will be highest in the center.

DR. ALEX. C. WIENER'S CASE.

F. D —, a healthy, strong man, aged 28 years. While unloading railroad iron fell backward, with a rail crossing his abdomen. Became unconscious immediately, but soon reacted, was taken to his home, and went to bed. Was unable to urinate; had severe vesical tenesmus. In the evening he became tympanitic and complained of great pain in the abdomen. The following morning the patient collapsed; pulse 130; temperature sub-normal. Abdomen very tympanitic; dullness over lower portion of abdomen, having the outline of a very much distended bladder, or an ovarian tumor. Catheterization produced only a few drops of bloody urine.

Diagnosis: Extra-peritoneal rupture of the bladder; *sectio alta*. Removed to the Stadt-krankenhaus. As soon as the deep fascia and

the pre-vesical space was opened there was a gush of bloody urine, as if under considerable pressure. Deep down in the sub-peritoneal space was found a contracted bladder, in the apex of which was an opening three quarters of an inch in diameter. The peritoneum was pushed up into the abdomen, and a large quantity of fluid had accumulated in a sac, surrounded by peritoneum above. As the fluid escaped the peritoneum fell back in the direction of the bladder. The opening in the bladder was sewed with silk, and a drainage tube inserted in the sub-peritoneal cavity between the bladder and the peritoneum. This was removed on the third day. There was no fracture of the pelvis. The patient made an uneventful recovery, and was discharged from the hospital in four weeks.

This case illustrates beautifully the method in which the peritoneum is separated from the bladder, and the large quantity of urine that may be accommodated, without rupture into the peritoneal cavity. It also illustrates the indication for treatment in those cases where there is laceration; that of immediate suture of the bladder and thorough drainage between it and the peritoneal cavity.

In this class of cases it can be readily seen why the peritoneum is pushed in advance of the urine, and forms a second urinary sac (extra-peritoneal), between the peritoneum and

the wall of the contracted bladder. It can also be seen that an exploration of the bladder from the perineum, and through the perineal section with the finger is not possible, particularly if the patient be at all obese, and even if you find a laceration in the bladder you cannot determine whether the laceration continues through the peritoneal coat, or whether the peritoneum be pushed forward ahead of the fluid and separated from the other coats of the bladder. The proper operation for such cases, both with a positive diagnosis of intra-peritoneal rupture, or with a doubtful diagnosis of intra-peritoneal rupture, or with a diagnosis of rupture into the cellular tissue, is a supra-pubic section. The bladder can be opened through this incision and explored without opening the peritoneal cavity, and if the urine be sub-peritoneal, it can be drained through this opening. If the opening in the bladder be sub-peritoneal it can be sewed through this incision. If the rupture is intra-peritoneal, the peritoneum can be opened by increasing the incision an inch upward, and the cavity can be irrigated and drained through the same opening. A permanent drainage of the bladder can also be made through the latter, thus placing it in a most favorable condition to keep the escaping urine aseptic. With a glass speculum the surface of the bladder can be thoroughly examined with the eye as

well as digitally. The ureter can be examined and re-united if ruptured, and hemorrhage can be suppressed, all through the same incision.

In other words, every indication (immediate and remote) in connection with intra-peritoneal rupture of the bladder can be made by this method of operating, and that without jeopardizing the patient by the operation itself, or the function of the neck of the bladder during subsequent years. It was first suggested by Gutesbock, and performed by Mikulicz. After the bladder is open a careful examination of the surface should be made, not alone for one opening, but for many, as the rupture is frequently multiple. The usual incision for supra-pubic section should be made. The tissues will be found infiltrated with blood and urine; the bladder will be found deep in the pelvis and contracted. It cannot be elevated with a rectal bag in these cases. When the bladder is opened and the anchor stitches are placed in position a digital exploration may be made, and then an examination with a speculum. If it is found that the bladder is ruptured into the peritoneal cavity, the incision should be enlarged upward, and the peritoneal cavity opened. The bladder closed with a Czerny-Lembert suture. The peritoneum should then be thoroughly cleansed, thoroughly irrigated with a salt solution, the ureters examined, and a large glass drain in-



sented. The bladder should be sutured to the abdominal wall, and a speculum or a drain an inch in diameter retained in the opening in the bladder. It can in this way be frequently irrigated.

What are the dangers? First, there is danger of peritonitis from the effect produced to the peritoneum by the urine. In these cases death occurs as a rule from the third to the fifth day. Second, there is danger of absorption of the infiltrated urine in the pelvic cellular tissue. Third, there is danger from necrosis of the cellular tissue, and extensive sloughing produced by the decomposed urine.

The indications, therefore, are: prevent further contact of the urine with the peritoneum, and provide thorough external drainage for the urine from the bladder. This cannot be done with a small drainage tube, nor with a siphon, but must be done with a glass speculum an inch in diameter. Where the peritoneum is separated from the bladder wall and the wall of the abdomen, and the urine rests in the sub-peritoneal space, great care should be taken not to open the peritoneal cavity, but to drain by a supra-pubic incision, as in the case kindly furnished me by Dr. Alex. C. Wiener.

Wherever there has been a urinary infiltration in any tissue, the most careful provision must be made for drainage, as it rapidly de-

composes when exposed; and when decomposed its destructive effect is very great.

The most common ruptures of the bladder are those of the neck; and they are usually associated with fracture of the pelvis. The symptoms are very similar to those above-mentioned, except that the area of dullness does not extend up in the direction of the peritoneal cavity; but there is infiltration, tenderness, tumor in the supra-pubic space (or evidences of tumor), and an infiltration to be felt in the pelvic cellular tissue through the vagina or rectum. Where we are able to expose the laceration in the bladder, and through that to explore the bladder for other lacerations, it is not necessary to make an incision into the bladder. But where we are unable to locate the opening in the bladder, it should be opened supra-pubically, the location of the wound determined, and the same sutured. With immediate suture of the incision in the bladder we should resort to drainage of the space between the bladder and peritoneum for three or four days, until we determine whether or not primary union will take place. It is unnecessary in these cases to keep the bladder in the external wound. It is also unnecessary to keep it open, as we can drain the line of suture and incision thoroughly after they are approximated; and in case of leakage it will not escape

into the cellular tissue and through the peritoneum, but along the line of free drainage.

There should be free incision into the infiltrated area, and the most thorough antiseptic precautions taken. The tissues should be irrigated and constantly saturated with a boric acid solution.

#### LACERATIONS OF THE URETHRA BELOW THE TRIANGULAR LIGAMENT.

These are by far the most common injuries to the urinary tract. A kick, a blow, a fall, striking on a hard body with the perineum very frequently lacerates the urethra, with or without a fracture of the pelvis. More frequently without. These lacerations may be divided into partial and complete, that is, first, in cases where the urethra is torn only for a portion of its circumference, where it is possible for the patient voluntarily or with the aid of the catheter to evacuate the urine; and second, where there is complete laceration, and when the patient makes an effort to urinate he feels an intense burning and sense of pressure in the perineum.

Method of production: The urethra is impinged between the foreign body and the symphysis and lacerated; the force of a sharp object pressing the urethra against the corpus cavernosum may produce the laceration; or the laceration may be produced by a fracture

of the pelvis, or by penetrations of the perineum. (See Fig. II.)

Symptoms: Hemorrhage from the meatus; pain and burning in the perineum; inability to urinate, and when an effort is made, pain, burning and pressure are experienced in the perineum.

In these cases it is not uncommon to have

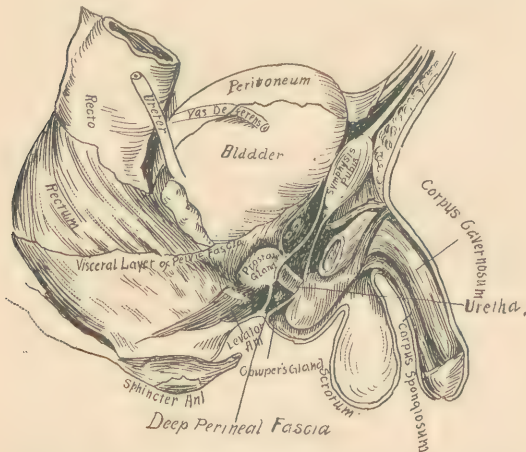


FIG. 2. ILLUSTRATING RELATIONS OF TRIANGULAR LIGAMENT (DEEP PERINEAL FASCIA) TO URETHRA, ETC. (FROM GRAY).

an infiltration of urine in the cellular tissue of the thigh, and along up the cellular tissue of the abdomen in the direction of the umbilicus. But if a case receives proper treatment at the start, that is, early operation and drainage, this does not take place.

Physical signs: Swelling and infiltration of the perineum; tenderness on pressure; inability to pass catheter; distended bladder.

Pathology: When the urethra is lacerated partially, or completely, the patient is unable to urinate; or if he does, it is but little and very painful. The urine is forced out by the contraction of the bladder, and through the lacerations into the cellular tissue of the perineum into the corpus spongiosum; and the quantity may be so great as to produce a distinct swelling of the perineum, the buttocks, or even pass up onto the side of the leg. Catheterization, if attempted, is ineffectual in relieving the bladder. The urethra at the point of laceration is thereby infected, and we have a rapid decomposition of the urine in the cellular tissue, and a further infiltration at each effort to urinate. The distress becomes so great that the patient must have relief.

The indications are: First, to relieve the distended bladder. Second, to relieve the urine from its retention in the perineum. Third, to provide a permanent and free escape of the urine. Fourth, if the tissues are extensively infiltrated, to give free exit to the fluid producing the infiltration. Fifth, to re-unite the urethra.

The distended bladder is relieved by (a) the passage of a soft rubber aseptic catheter, with the hands and genitals thoroughly disinfected.



If this fails (and it should not be persisted in for too long a time), the next indication (b) is immediate perineal section for the relief of the distended bladder and infiltrated perineum, at the seat of the laceration. One of the greatest difficulties in this operation is finding the proximal end of the urethra, particularly after the case has existed for a number of days. The steel sound or silver catheter should be passed down into the opening of the urethra; a free incision should then be made and the end of the catheter and the tissues carefully inspected; and with a grooved director an endeavor made to locate the proximal end of the urethra. The tissues may be found cut, torn, lacerated, in fact mutilated, without greatly jeopardizing the patient. The prostatic and membranous portion of the urethra may be proximately located by passing the finger into the rectum and following it down. The search for the urethra may be kept up for an hour. If success has not attended by that time, it is advisable to allow the patient to come from under the influence of the anæsthetic, and have him endeavor to urinate. The urine will frequently flow out through the wound. You have then accomplished the first and second indications. With the urethra thus opened the urine may escape through the wound immediately on the patient's efforts to urinate. The proximal end of the urethra

can then be readily located, and should be joined by suture, where it is possible, to the distal; and an opening retained for permanent drainage.

If it be impossible for the patient to urinate after this procedure, and the urethra has not been found, his bladder may be aspirated with a fine needle in the supra-pubic position; or a supra-pubic cystotomy may be performed, though this is rarely necessary. When the urine escapes freely through the perineal wound in the efforts at urination, it is not necessary to keep in the catheter. Indeed, it is highly desirable that it should not be used at all. If it is impossible to bring the ends of the urethra together, a catheter should be inserted into the urethra and passing down to the sphincter, and retained there to aid in the formation of a permanent canal.

On what class of cases of laceration of the urethra should we perform perineal section? On every case of traumatism to the perineum in which the urethra is involved; where there is hemorrhage from the meatus; a material diminution in the size of the stream; and where it is impossible for the patient to urinate and the catheter does not readily pass into the bladder. By this I mean, in every traumatism where the urethra is lacerated sufficiently to allow of infiltration of urine into the peri-urethral tissues. Yes, I will even go further,

and say in every traumatism to the perineum where there is hemorrhage from the meatus, and where the patient cannot urinate voluntarily and freely.

When should this operation be performed? At the time when the attending physician endeavors to pass the catheter for the first time after the injury. There should be no attempt at catheterization unless everything is in readiness for an external urethrotomy. If the patient goes for hours without urinating after the injury, there is no material destruction in his perineum, as the urine is aseptic, and it infiltrates the tissue slowly; but just as soon as the catheter is passed, just so soon is decomposition of the urine set up, and immediately the destructive effect of the decomposed urine on the tissues commences.

The operation in the early stage is a very simple one, that is, within three or four, or even ten hours after the injury, as the tissues still retain their natural color; impart about a natural sensation to the touch; can be recognized by their appearance; and are still in their proper anatomical relations. Now this is all changed in twenty-four, thirty-six or forty-eight hours, particularly if the doctor has spent an hour or two trying to pass a metallic catheter through the urethra. In my opinion the metallic catheter in traumatisms of the urethra is a surgical abomination. Its only

potentiality over the elastic is its power to do damage. A soft catheter will pass if the urethra be permeable. A hard catheter cannot be forced into the bladder after it has escaped from the normal tract of the urethra without making a false passage. It is merely forced into the perineum, into the peri-vesical cellular tissue through the triangular ligament; yes, it has been recorded many a time that it was forced into the peritoneal cavity. It should never be used for the purpose of catheterization in the presence of laceration. Its only use should be as a guide to the position of laceration.

What are the evil consequences of such a procedure? First, the perineum is severely lacerated around the urethra. Second, the triangular ligament may be perforated, and the pelvic cellular tissue then become infiltrated. Third, the opening in the urethra is made larger; the tissues in the perineum are so torn that the urine freely infiltrates the perineum; and worse than all this, the laceration in the urethra is infected, and decomposition of the urine is set up. As a consequence of the infiltration and decomposition we may have the perineum, the scrotum, the corpus spongiosa entirely destroyed, so that the testicles become uncovered and even the tissues of the abdomen may become necrotic. It has been my painful experience to see

three of these cases during the last two years. In all three the entire urethra, from the position of laceration to the meatus, was destroyed; the skin and cellular tissue of the penis destroyed, the testicles left without a particle of dartos to cover them; and though the patients succeeded in escaping with their lives, one of them lost both testicles, one lost one testicle, and in another the testicles were covered with a flap from the thigh; and in all three the patients were compelled to urinate subsequently through a perineal fistula. These are three extreme cases, and true, are only met with in extensive hospital practice; but every surgeon, even with limited practice, has seen examples of lesser degrees of severity of perineal fistulæ, destruction of two or three inches of urethra, sloughing of a portion of the scrotum, or perineum, two or three months of confinement to bed from infiltration, and not so very infrequently deaths from sapremia.

We, as railroad surgeons, should consider ourselves as a body of organized men where each individual feels it his duty to cry down careless, meddlesome, pernicious, yes, even criminal catheterization after lacerations of the perineum. The pocket catheter must go, and its place in the perineum must be supplanted by the guide and scalpel.

An incision into the urethra has little more danger than an incision of the



same size and depth into the calf of the leg. When I speak of incisions of the perineum into the urethra, I imply always incision into the urethra below the triangular ligament. We are never justified in passing beyond that landmark in any effort to enter the bladder. Furthermore, we are never justified in performing the so-called Coxe's operation, that is, putting the finger into the rectum, and stabbing for the apex of the prostate. In my internship in the county hospital I saw two cases of this class. In both of them the triangular ligament was opened into the cellular tissue, and both patients died from pelvic urinary infiltration and sapremia. When we are unable to get a guide into the bladder or find the urethra below the ligament, we have always left that simple and safe operation, supra-pubic section.

Laceration and traumatism of the ureter occur most frequently with fractures of the pelvis or severe contusions of the abdomen, and are produced by penetration into the pelvic cellular tissues, or they may occur in abdominal operations. They may be: (a) extra-peritoneal (b) intra-peritoneal. If they are extra-peritoneal, the urine will accumulate beneath the peritoneum, and there will be a bulging cystic tumor at the position of laceration. This may be either above or below the pelvis. The urine immediately after the laceration may

have a small quantity of blood, or, if the ureter is still patulous, the blood may continue in the urine for some time after the accident. If the laceration is intra-peritoneal, we have all the symptoms of the escape of urine into the peritoneal cavity, inflammation, vomiting, shock, etc. It is not uncommon after the first bloody urine passes to have the urine remain clear throughout the course of the case.

The indications are, if extra-peritoneal, that the operation should be performed extra-peritoneally. The operation on the ureter above the pelvis can readily be made in this manner by an elongation of the incision usually made for lumbar nephrectomy, one inch anterior to the ilium, and down to the middle of Poupart's ligament. The peritoneum can then be pushed forward as in ligation of the iliac; and the ureter can then be exposed from the brim of the pelvis to the kidney. By this operation the danger of cellular infection is increased; but the danger of peritonitis, which is the graver, is avoided. When the ureter is exposed, if it be completely severed, the method of ureterectomy originally suggested and performed by Dr. Weller Van Hook of this city, is the best method for re-uniting it.

If the laceration be longitudinal, it can be sewed and united by extra-mucous sutures of

silk or catgut. If the laceration be transverse, and the ureter only partially divided, the method of elongation and lateral suture of Dr. Christian Fenger should be adopted.











